# NUTRITIONAL STATUS AND PREVALENCE OF ANEMIA IN RURAL ADOLESCENTS

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## CERTIFICATE

Certified that this dissertation entitled **" NUTRITIONAL STATUS AND PREVALENCE OF ANEMIA IN RURAL ADOLESCENTS"** is a bonafide work done by **Dr.R.EZHILARASU,M.D**., Postgraduate student of Paediatrics Medicine, Institute of Child Health and Hospital for Children, Egmore, Chennai –8 attached to Madras Medical College, during the academic year 2003-2006.

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## DECLARATION

I declare that this dissertation entitled "**NUTRITIONAL STATUS AND PREVALENCE OF ANEMIA IN RURAL ADOLESCENTS"** has been conducted by me at the Institute of Child Health and Hospital for children, under the guidance and supervision of my unit chief **Prof.Dr.MANGAYARKARASI SENGUTTUVAN, M.D., DCH.** It is submitted in part of fulfillment of the award of the degree of M.D [Paediatrics] for the September 2006 examination to be held under The Tamil Nadu Dr. M.G.R. Medical University, Chennai. This has not been submitted previously by me for the award of any degree or diploma from any other university.

**Dr.R.EZHILARASU**

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## INTRODUCTION

Adolescence is a period of transition between childhood and adulthood. This period occupies a crucial position in the life of human beings on account of major physical, sexual and psychological changes. This period is characterized by an exceptionally rapid rate of physical and sexual growth. The peak rates of physical growth are exceeded only during the fetal life and early infancy. There is not much individual variation in the growth during the fetal life and infancy. In contrast there is much more individual variation both in timing and in the degree of growth during adolescent period. This has importance in defining normality.

The United Nations committee on nutrition met in OSLO in 1998 suggested that, more data on health, nutrition of adolescent children to be collected in order to assess magnitude of health needs of adolescents. It also believed that the scale of nutritional problems among adolescents might have been previously under estimated.

Traditionally, health planners / policy makers have been utilizing mortality indicators as indicators of health in the community. Allocation of resources for health is based on mortality indicators among infants, children below 5years and women of reproductive age group. Adolescents have the lowest mortality among different age groups. Therefore the allocation of resources reserved on health needs of adolescents received and continue to receive very low priority. In developing countries like India, recently there has been a change in attitude of planners in view of the HIV pandemic affecting predominantly late adolescents and youth population. The Priority was according to the research on reproductive health needs, HIV, sexually transmitted diseases and basic research on the nutritional, psychological needs for the growth and development of adolescents is not been concentrated upon.

Though many studies have been done in the nutritional needs of adolescents, few studies have shown that the prevalence of malnutrition is high in this group. The requirements of calories and micronutrients like iron, folic acid, vitamin B12, zinc, copper, vitamin E and calcium is very high during the period of rapid physical growth like adolescence. Few other studies have also shown that the prevalence of anemia was also high among the adolescents.

Studies done in our country have also shown that the prevalence of anemia and malnutrition among adolescents are high. But most of these studies were done in the urban areas of India. These studies do not reveal the actual prevalence of anemia and malnutrition among adolescent in the rural areas, thus underestimating magnitude of the problems among adolescents, especially in the rural adolescents. It should be remembered that 60 to70% of the population in India are living rural areas.

## ADOLESCENCE – AN OVERVIEW:

This period usually defined by the rapid onset of biological and

psychological growth and development prior to or at the second decade of life and ending before age 20. As per the definition of W.H.O, the adolescence as a period between 10 years to 19years of age in both sexes, undergo rapid changes in body size, shape, physiology and psychological and social functioning. Hormones set the developmental agenda in conjunction with social structures designed to foster the transition from childhood to adulthood.

1.2 billion adolescents are living in developing countries making $1/4^{th}$ to $1/5^{th}$ of their countries population. As per W.H.O estimates, adolescents constitute 25% of world population. In India 23% of total population are adolescents making almost 230 million.

Adolescence proceeds across three distinct periods early, middle and late (NCERT 1999) – each marked by a characteristic set of salient biologic, psychological and social issues. However individual variation are substantial, both in terms of the timing of somatic changes and the quality of the adolescent's experience. Gender and subculture profoundly affect the developmental course.

- **EARLY ADOLESCENCE:**
  - Defined as adolescents from 10 years to 13 years of age group in both sexes.
  - Sexual maturity rating in this age group is around 1 to 2 (prepubertal).
  - Secondary sexual characters begin in this group. Growth acceleration also begins in this group.

Sexual interest actually exceeds sexual activity, pre occupied with changing body self-consciousness. Transition from concrete operational thinking of school aged children to form logical operations occur in some of the early adolescence but some acquires this later. Self-consciousness increases exponentially in response to somatic transformations of the puberty. It is normal for the early adolescence to scrutinize their appearance and to feel that everyone else is staring at them too. Girls in particular are at risk of viewing themselves as overweight. Dieting behavior is common and girls who rate themselves as fat or out of shape may be at increased risk of depression. Several body image distortions such as anorexia, nervosa are also common in this age group. They often socialize same sex peer groups. Female friendships may center on sharing confidences, where as male relationship may focus more on shared activities and competition. Discordance between chronological age and sexual maturation may increase the stress in early adolescence. Early maturing boys enjoy greater social success and higher self esteem than do those who mature later. For girls by contrast, early maturation is associated with poor school performance and lower self-esteem.

- **MIDDLE ADOLESCENCE**:
  - Defined as adolescents from 14 years to 16 years of age group in both sexes.
- Sexual maturity scoring is around 3 to 5(pubertal).
- Growth accelerates to about the prepubertal linear growth rate of 6-7 cm per year.

In average, girl growth spurt peaks at 11.5years at a top velocity of 8.3 cm per year and then slows to a stop at 16 yrs. In the average boy, growth spurt starts later, peaks at 13.5 yr at 9.5 cm per year and then slows to a stop at 18 yrs. Weight gain parallels linear growth with a delay of several months, so that adolescents seem first to stretch and then fill out. Pubertal weight gains account for approximately 40% of adult weight. Muscle mass also increases followed by an increase in strength. Boys show greater gain in both lean bodies mass and in strength. Lean body mass approximately 80% in the average prepubertal child increases in boys to 90% and decreases in girls to 75% as subcutaneous fat accumulates. Doubling in of heart size and lung vital capacity occurs when compared preadolescent norms. Blood pressure, blood volume and hematocrit rise particularly in boys. Androgenic stimulation of sebaceous and apocrine glands results in acne and body odor. Physiological increase in sleepiness may be mistaken for laziness.

The timing of menarche appears to be determined by genetics, nutritional status, chronic illness and exercise. Both the sexes will have sexual drive, surges, and sexual experimentation. They will have questions of sexual orientation. Emergence of abstract thought, questioning more occurs in this age group. They are more concerned with physical attractiveness. Puberty commonly results in strained relationships between adolescents and their parents. As part of separation, adolescents may become distant from parents, redirecting emotional and sexual energies toward peer relationships. Physical attractiveness and popularity remain critical factors in both peer relationships and self esteem.

- **LATE ADOLESCENCE**:

- Defined as adolescents from 17years to 19years of age group in both sexes.
- Somatic changes in this period are modest by comparison.
- The final stages of breast, penile and pubic hair development occur by 17-18yrs of age in 95% of males and females.
- Minor changes in hair distribution often continue for several yeas in males.
- Sexual experimentation decreases as adolescents adopt more stable sexual identities.
- Cognition tends to be less self-centered.
- Slowing of physical changes permits the emergence of a more stable body image.
- In contrast to the often-superficial dating relationships of middle adolescence, these relationships increasingly involve love and

commitment. Carrier decisions become pressing on adolescents because self-concept is increasingly bound up in the emerging role in the society.

**PROBLEMS OF ADOLESCENCE**:

Most morbidity during adolescence originates from the following categories:

1. Risk taking behaviors
   - Substance use and abuse
   - Unintentional injuries (motor vehicle accidents)
   - Sexual behavior (sexually transmitted diseases, pregnancy in unmarried adolescent girls, illegal abortions)
2. Mental health problems
   - Suicide (more in late adolescents)
   - Depression (more in female)
   - Eating disorders like anorexia, nervosa or bulimia nervosa (mostly in post pubertal adolescents)
3. Menstrual problems
   - Polymenorhea
   - Oligomenorhea
   - Metrorrhagia
   - Menorrhagia
   - Dysfunctional uterine bleeding.
4. Over weight
5. Malnutrition
6. Micronutrients deficiency like iron deficiency anemia.

**ADOLESCENT NUTRITION:**

There is increasing concern about the negative consequences of malnutrition in adolescent girls and young women for their offspring and themselves. Renewed action to address the nutritional problems and needs of adolescents is therefore a priority.

While adolescents have typically been considered a low risk group for poor health, this ignores the fact that many health problems later in life can be improved or avoided by adopting healthy lifestyle habits in adolescence.

There is substantial evidence that inadequate diets affect adolescent's ability to learn and work at maximum productivity. Under nutrition increases the risk of poor obstetric outcomes for teen mothers and jeopardizes the healthy development of their future children. Children born to short, thin women are more likely themselves to be stunted, underweight and less cognitively able than normal birth weight peers. In addition, the heightened obstetric risk caused by stunting in childhood and adolescence persists throughout a woman's reproductive life.

Adolescence is also a unique intervention point in the life cycle. It is a stage of receptivity to new ideas and a point at which lifestyle choices may determine an individual's life course. It offers a chance to acquire knowledge about optimal nutrition during young adulthood that could prevent or delay adult-onset diet-related illnesses later on. Potentially, the inclusion of adolescent boys in nutrition and healthy lifestyle programs will contribute to the improved nutrition and health of women during childbearing and for infants and young children in the critical early years of life.

Attention needs to be directed at the link between adolescent nutrition and immediate and long-term health issues, including the cost effectiveness of addressing adolescent nutrition, so that the political commitment to support an action agenda can be secured.

**ANEMIA - A GENERAL HEALTH PROBLEM:**

Anemia is a major public health problem worldwide. It estimated that around 2 billion people, 30% of the world population, are affected (DeMaeyer & Adiels-Tegman,)[13], with the majority coming from the developing world. Infants, pre-school children, adolescents, and women of childbearing age, particularly pregnant women, are at greatest risk of developing anemia. It is reported that 56% of pregnant women in developing countries and 18% in the developed countries are anemic, and in Asia the estimated prevalence in pregnant women is 50%-60% (WHO, 1992). For the non-pregnant women the estimated prevalence is 43% in developing countries and 12% in the developed countries. Inadequate food intake, and / or frequent parasitic infestations, menstrual irregularities and frequent pregnancies are the common reasons in the developing countries.

Adolescents and school age children are also vulnerable groups, and an estimated 37% of school age children are affected. The causes of anemia are multiple, but iron deficiency is by far the most important nutritional anemia worldwide (DeMaeyer et al., 1989) [13].

- **ANEMIA IN ADOLESCENTS:**

During adolescence, the growth spurt increases the need for iron, and, for the girl, there is further increase due to regular menstrual loss. In the developing countries, the high iron demands in these groups are not met, mainly because of the poor diet of low iron bioavailability, and frequent parasitic infestations, thus leading to a high incidence of anemia in women and girls. An adolescent who conceives soon after menarche is likely to start pregnancy with depleted stores. Adolescent pregnancies are common in developing countries and anemia is one of the serious health problems for the girls. Nutritional demand on woman, after pregnancy and lactation has no time for physiological recovery before a subsequent pregnancy.

- **CONSEQUENCES OF ANEMIA**

Anemia has detrimental physical, social and economic effects. Even mild to moderate anemia affects the sense of well being resulting in fatigue, stress, and decrease in work capacity.

Severe anemia that occurs in developing countries is a major cause of maternal mortality and morbidity (Harrison & Rossiter, 1985; WHO, 1992). Anemia is attributed as a direct or indirect cause of about 26% of maternal deaths in Asia. Severe anemia may cause cardiac failure and death, whereas chronic anemia is considered to be contributory, especially in cases of hemorrhage and infection. Furthermore, anemic women are poor anesthetic and operative risks, as

anemia may lead to poor healing of the wound and to increased susceptibility to infections. The extent to which anemia may cause maternal deaths is also dependent on availability and quality of obstetric services. Availability of blood transfusion is often lifesaving in cases of severe anemia.

Anemia during pregnancy is also associated with an increased risk of intrauterine growth retardation, premature delivery and low birth weight, resulting in an increase in perinatal mortality. Infants of anemic women are born with reduced iron stores and are at risk of anemia during infancy and increased risk of infant morbidity and mortality. Reduction of anemia during pregnancy is therefore a key component of safe motherhood.

**NUTRITIONAL ANEMIA**

It is the commonest of all anemias seen in the adolescent especially in the developing countries like India. It may be defined as a condition that results form the inability of the erythropoietic tissue to maintain a normal hemoglobin concentration on account of inadequate supply of one or more essential nutrients.

❖ **Iron deficiency anemia**

The iron deficiency anemia (IDA) occupies the major chunk as a cause of anemia in childhood and adolescence. It continues to be a major public health problem even now as we are stepping into the next millennium! In public health terms, iron deficiency is by far the most important cause of nutritional anemia. Iron deficiency may result from a combination of several factors, including

(1) Inadequate dietary intake and/or low dietary availability,
(2) Increased iron needs during pregnancy and periods of rapid growth such as adolescence,
(3) Chronic iron losses due to parasitic infestations such as hookworm and schistomiasis,
(4) Impaired iron utilization in chronic and repeated infections. The main source of iron in the diet in India is non-heme iron.
(5) The absorption of non-heme iron can be further hampered by dietary components such as phytates, tannates, calcium phosphate and fiber.

Iron deficiency anemia is particularly prevalent in adolescents and children as compared to adults because rapid growth imposes large iron needs and because most Indian diet have a marginal supply of iron. It is the commonly recognized form of nutritional deficiency in developing countries as well as in affluent societies. It is widely prevalent almost all over the world. Because of their rapid growth and scanty storage iron any interruption in supply of iron from diet of adolescents makes them unusually vulnerable. Repeated and chronic infections play a major role.

❖ **Other nutrient deficiencies**

There is a general consensus that in poor countries diets tend to be deficient in multiple micronutrients and not only of iron and folate. Deficiency of vitamin B12, vitamin A, as well as zinc also contribute to anemia but the extent of

these deficiencies in the region has not been determined. The need for national research to determine the extent of these other deficiencies has been emphasized as it has implications on supplementation policies for vulnerable groups.

- **INTERVENTIONS FOR ANEMIA**

The control of anemia in women of childbearing age is a priority public health problem (WHO, 1992). Haematinic supplementation is recommended for all adolescent girls in high anemia prevalence areas in developing countries. This approach had only limited success, except under well-controlled conditions. The reasons for this vary, but general problems are logistics to ensure availability and distribution of tablets within primary health care (PHC) settings of care, as well as inadequate supervision of providers (UNICEF, 1998; Yip, 1994). Problems of compliance with prophylactic medication by women are another possible contributing factor. Several studies have shown that logistic problems inherent in PHC programmes such as lack of supplies, distribution, supervision of health providers and adequate information to pregnant mothers were more significant (Galloway & McGuire, 1994). The other main reason for the limited success is that anemia is prevalent even in non-pregnant women and the treatment period in pregnancy is too short to correct it. Furthermore, the often-multifactor causes of anemia cannot be addressed by supplementation of iron and folate alone (Meda et al., 1996;Viteri, 1997b). For this reason, WHO recommended local studies to be undertaken for each region, to provide baseline information for design of prophylactic and therapeutic regimes (WHO, 1989).

## REVIEW OF LITERATURE

1. K. Anandh and S. Kanth et al[8] conducted a study on December 1998 to march 1999 on nutritional status among adolescent school children in rural north India. Outcome measures are height, weight, and Hemoglobin percentage and body mass index in class 6$^{th}$ standard to 12$^{th}$ standard. This study concluded that stunting among girls 37.2% and among boys 41% with overall incidence of about 38.5%, Thinness of about 43.8% among boys and 30.8 among girls. Anemia was 38% among boys 42.5% among girls.
   - This study was done only in school going adolescents and it does not reflect the problems in non-school going adolescents.
   - Only stunting was mentioned. There is no mention about undernourished and overweight.
2. K. Venkaiah and K. Dhamayandhi et al[24] from National Institute of Nutrition, ICMR, Hyderabadh conducted a study from 1996 to 1997 on Diet and nutritional status of rural adolescence in India. Outcome measures are Height, Weight and BMI. They also used the 24 hrs dietary recall method. In the conclusion of this study the investigations found that the under nutrition was less common in girls

compared to boys in adolescent age group.

- Age wise parameters were not mentioned

3. S. Jayalakshmi et al[9] 1991 conducted a study on the status of adolescence girls in rural south Indian population. Outcome measures are Height, Weight and BMI. They also utilized 24 hrs dietary recall technique. They concluded that the growth was poor in 34.7%. They also measured the Hemoglobin percentage among the girls and found 73.5% are anemic.

- Study was done only among girls.
- Highlights of the study were that adolescent girls were malnourished and very high percentage of them found to be anemic.

4. Rajarathnam Abel et al[4] from Christian Medical College, Vellore, has done a study on prevalence of anemia among adolescent girls in rural Tamilnadu[4]. This study was done during August 1998 to October 1999. They measured height, weight, BMI and Mid arm circumference. In the conclusion of the study they found that anemia prevalence of about 44.8% Severe anemia 2.1% mild anemia 42.%. Anemia is more common in the post menarcheal age group (45.2%) than in the menarcheal age group 40.7%.

**5.** Singh .N, Mishra et al[5] department of Home Science, Mahila maha Vidhyalaya, Banarus Hindu University, Varanasi conducted a study on nutritional status of adolescent girls of a slum community of Varanasi. They measured height, weight and BMI. The results of this study is 70.0% of adolescent girls had BMI of <20%, 51.43% of adolescent girls are suffering from chronic energy deficiency. Stunting was present in 10% of adolescent girls. Their average weight, height and mid arm circumference were 83.45%, 93.08% and 82.05% of the corresponding reference values.

- Age wise parameters could have given better ideas.

6. Srivastava .M and Agarwal etal[7] done a study on nutritional status of rural non-pregnant non-lactating women in reproductive age group on 1998 October in Varanasi. They concluded that 50% of rural UttarPradesh women in pre pregnancy state are under nourished.

**7.** Sardha Sidhu et al[13] has done a study on prevalence of anemia among adolescent girls in a particular community of Punjab. They estimated the Hb with cyanmethemoglobin method. This study showed that only 29.43% girls were normal. 70.57% of girls were affected with various grades of anemia. 57.68% were mild anemia while 12.83% suffered from severe anemia. Severe anemia had its wrath in the age group of more than 15 years.

- The study was done only in a particular community. Hence it does not reflect the general problems of adolescents.

8. Chondhary .S et al[6] done a study on energy balance of adolescent girls in rural area of Varanasi[6.] Nutritional status of study subjects was assessed on the basis of BMI. They concluded in

their study that 68.52% of study subjects had BMI of less that 18.5 $Kg/m^2$.

- Age wise parameters could have given better ideas.

9. Sabita Basu and Srikanta Basu et al[18] prevalence of anemia among school going adolescents of Chandigarh. This study was done in 1120 apparently health adolescents sampled from 11 city and 2 rural schools in Chandigarh. All the boys and girls subjected to anthropometrics examination and hemoglobin estimation method. BMI calculated from anthropometrics measures and compared with National Center for Health Statistics standard charts, less than $5^{th}$ percentile for particular age is undernourished. The over all prevalence of anemia calculated as per W.H.O guidelines was significantly higher among girls (23.9%) as compared to the boys 7.7%. Anemia was significantly less among the urban school going adolescents than rural school going ones. Both girls and boys 15.3% of the rural group was significantly more anemia than girls (21.5%) and boys (6%) of the urban group. 14.3% girls and 14.2% boys were under nourished (BMI < $5^{th}$ percentile). Prevalence of anemia in undernourished girls was more than well nourished (21.9%). Similarly boys 6.7% are anemia in well-nourished group as compared to 14.4% in undernourished group.
10. Leshan L et al [19] done a study in Family Practice Center, Medical College of Wisconsin, Milwaukee, US. The prevalence of anemia in urban indigent African-American adolescents .50% of the girls had hemoglobin levels less than 120 g/L. 16.5% of boys had hemoglobin levels less than 120 g/L.

**STUDY JUSTIFICATION**

Adolescents constitute almost one fifth of world population. In developing countries like India, the adolescents constituting one fourth of population are not given the due importance in terms of resource allocation on health care or research. Though adolescence is a period of rapid body growth, inadequate nutrition, poverty and literacy constitute greatly to thin malnourished adolescents. Heightened sexual drive, sexual urge and sexual experimentation lead on to the teen-aged pregnancies and illegal abortions. Early marriages of these thin adolescents results in prematurity, low birth weight babies with high neonatal mortality. This vicious cycle has not been truly recognized in view of lopsided research among the urban adolescents only. Exposure to hitech knowledge, per capita income and availability of health care personals especially those belonging to the middle and higher socioeconomic status in the urban areas make much difference between urban and rural adolescents. Studies done in urban areas have concentrated on these children only. Thus painting a lopsided picture of adolescent's health and nutritional status is not truly reflective of ground realities. This study was planned with the aim of gathering basic nutritional data among rural adolescents in order to project the nutritional needs to the health planners.

## OBJECTIVES OF THE STUDY

- To assess the nutritional status of the adolescent community residing in rural block.
- To assess the prevalence of anemia among these adolescents.

## METHODS:

- STUDY DESIGN : Community based cross sectional survey

- PLACE OF STUDY: Institute of child health and Hospital for Children, Egmore, chennai-8

- STUDY PERIOD : October 2004 to March 2006.

- STUDY POPULATION:
  - Inclusion Criteria:
    - 10 years to 19 years of both sexes (as per W.H.O guidelines).
    - Residents of that area
    - Those with valid date of birth
  - Exclusion criteria:
    - Migrating population.

- SAMPLLING FRAME:

  - Sample District: Thiruvallur District
  - Sample Area: Poonamallee block
  - Total population in that area 2,05,380
  - Total no.of adolescent population 42,000
  - No. of Villages : 90
  - Sample size : Based on the previous study by K.Anand etal[1] prevalence rate of anemia(40%) and prevalence rate of under nourished (37.3%)sample size was calculated as 1600 with the standard error of 5%. Since it is community based study Designer effect of two was considered. Hence the sample size is 3200.
  - Sample collected : 4067
  - Sampling technique: Systematic random Sampling

## MANEUVER:

Village chiefs and local health care providers were contacted first and permission was obtained to conduct health camps. Health camps were arranged in villages with the help of village chiefs and local health care providers. The adolescents were mobilized to attend health camps by means of prior sensitization. The sensitization meeting consisted of meeting village elders, leaders of local fans clubs and sensitizing them to the study. A convenient date for holding the health camp was fixed during this phase. In the next final meeting the place of camp, method of mobilization was finalized. Accordingly adolescents were mobilized by local health care providers, leaders of various fan clubs, Anganwadi workers and local N.G.Os(Lions clubs), youth club leaders. Where the number of adolescents was less in particular village, they were mobilized to next nearest village where the camp was held. 48 of such camps were organized during the 2 yrs period.

Adolescents and their parents were informed about the purpose of the study one week in advance with the help of local health care providers and village chiefs. Remainder was given two days prior to examination. Informed consent from parents as well as from adolescents was obtained. Detailed clinical examination was conducted. Height, weight and hemoglobin were measured.

- **Height:**

Height in cms was measured with the use of stadiometer. The adolescents were asked to stand on the base of the stadiometer. They were also positioned so that the line of vision will be perpendicular to the body. An upper scale was brought down to the top most point on the head. Height was recorded to the nearest of 1cm. The same individual recorded height in all the camps.

- **Weight:**

A bathroom scale was used to measure the weight. It was calibrated with known standard weights regularly. For standardization zero error was corrected every time. Weight was recorded to the nearest of 500 grams. The same individual recorded weight in all the camps.

- **Hemoglobin:**

Using the finger prick method blood was obtained after the first two drops were discarded. The blood Hemoglobin was estimated with the help of cyanmethemoglobin method. This was done with the help of calorimeter. The optical density was calculated. From the optical density standard formula given by manufacturer the Hemoglobin percentage was calculated. Known standards were run along with the test samples for maintaining quality control.

- **Body Mass Index:**

Body Mass Index calculated from the measure of height and weight.

**Body**

**Mass Index = weight / (height X height)**

The results of the Body Mass Index for each age group were plotted in growth charts using National Center for Health Statistics Standard adolescents' growth charts[23]. Those below the 5$^{th}$ percentile of that particular age and sex were defined as undernourished (thinned). Those in 85$^{th}$ to 95$^{th}$ percentile were defined as over weight for that particular age and sex. Those over the 95$^{th}$ percentile of that particular age and sex were defined as obese. Those in the 5$^{th}$ percentile to 85$^{th}$ percentile were defined as normal variants of that particular age and sex.

Prevalence of stunting was calculated by using National Center for Health Statistics recommended formula. Those less than 3$^{rd}$ percentiles in each age group and in both sexes were considered to be stunted.

- **Anemia:**

Definition: - Hemoglobin less than 12 grams were defined to be anemic (W.H.O). Hemoglobin 7 grams to 12 grams were defined to be mildly anemic. Those having Hemoglobin percentage of less than 7 grams were defined to be severely anemic. Hemoglobin more than 12 grams were defined to be normal.

Hemoglobin measured was analyzed with W.H.O standards of Hemoglobin percentage for anemia.

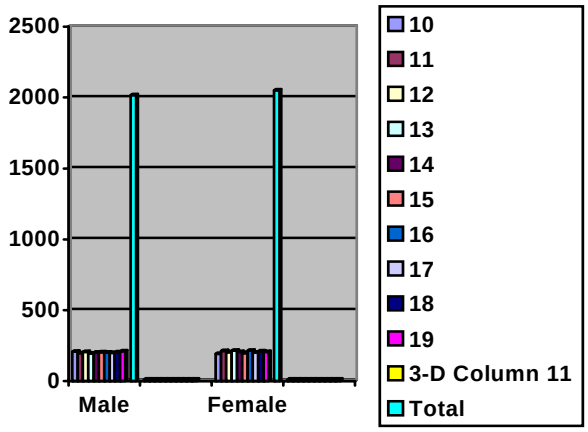
## STATISTICAL ANALYSIS:

All results were tabulated and percentage was arrived by using windows MS Excel application and analysis was performed by using SPSS version 11.0-Software. Descriptive statistics like frequencies and percentages were obtained. 95% confidence interval for the percentages was calculated. Chi-square test was done to compare between various groups. P value less than 0.05%was considered significant.

## RESULTS

Total No. of Villages : 90
Total No. of camps : 48
Samples were tabulated age wise, sex wise, school going and non-school going, Results were also tabulated according to various stages of adolescent period in both sexes.
No of adolescents enrolled: -
Total -4067
Male-2017
Female-2050

**Age and sex distribution of study samples**




Samples collected were almost equal in all age groups and were evenly distributed between both sexes

**TABLE 1:**

DISTRIBUTION OF SCHOOL GOING AND NON-SCHOOL GOING ADOLESCENTS IN THE STUDY SAMPLES

| Age | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | S | N.S | N.S % | S | N.S | N.S % |
| 10 | 202 | 6 | 2.8 | 189 | 3 | 1.56 |
| 11 | 191 | 5 | 2.5 | 208 | 4 | 1.8 |
| 12 | 198 | 8 | 3.8 | 196 | 7 | 3.4 |
| 13 | 187 | 7 | 3.6 | 203 | 10 | 4.6 |
| 14 | 187 | 13 | 6.5 | 185 | 20 | 9.7 |
| 15 | 180 | 22 | 10.8 | 165 | 32 | 16.2 |
| 16 | 163 | 37 | 18.5 | 180 | 35 | 16.2 |
| 17 | 156 | 42 | 21.2 | 136 | 64 | 32 |
| 18 | 102 | 101 | 49.7 | 65 | 144 | 68.8 |
| 19 | 108 | 102 | 48.5 | 48 | 156 | 76.4 |
| Total | 1674 | 343 | 17 | 1575 | 477 | 23.2 |

The non-school going constituted 17% among male and 23.2% among Female. As the age is increased, the number of school dropouts / those who did not

| | Male | | | Female | | | P value |
|---|---|---|---|---|---|---|---|
| | Total | N | % | Total | N | % | |
| School going | 1674 | 43 | 2.6 | 1575 | 49 | 3.1 | 0.02 |
| Non school going | 343 | 2 | 0.6 | 477 | 6 | 1.3 | 0.33 |
| Total | 2017 | 45 | 2.2 | 2050 | 55 | 2.7 | 0.35 |
| P value | 0.02 | | | 0.0003 | | | |

perceive higher studies increased steeply. That is at 17years the percentage of children who stopped perceiving their study increased to almost 50% in males and 70% in females.

**TABLE 2:**

NUTRITIONAL STATUS:
UNDERNOURISHED:

| | Male | | | Female | | | P value |
|---|---|---|---|---|---|---|---|
| | Total | N | % | Total | N | % | |
| School going | 1674 | 706 | 42.2 | 1575 | 479 | 30.4 | 0.00 |
| Non-school going | 343 | 163 | 47.5 | 477 | 187 | 39.2 | 0.02 |
| Total | 2017 | 869 | 43.1 | 2050 | 666 | 32.5 | 0.00 |
| P value | 0.07 | | | 0.0003 | | | |

- Males were more (43.1%) undernourished than female (32.5 %).
- Males were significantly more undernourished than female in both the school going and non school going groups (p value 0.07, 0.0003 respectively)

**TABLE 3:**

OVER WEIGHT:

- Of the school going males, 2.6% were overweight while 3.1% of female were overweight.
- Non School going 0.6% of male and 1.3% of female were overweight.
- Overall incidence of adolescents overweight among school going is 2.8% and non school going is 1.0%
- Both males and females going to school were at significantly more over weight when compared to non school going (p value 0.002, 0.0003 respectively)
- Among the school going males and females, females were at significantly more over weight when compared to males (p value0.02).
- There is no significant difference between male and female among the non-school going groups or the overall male and female adolescents.

**TABLE 4:**
OBESITY:

| | Male | | | Female | | | P value |
|---|---|---|---|---|---|---|---|
| | Total | N | % | Total | N | % | |
| School going | 1674 | 5 | 0.3 | 1575 | 8 | 0.5 | 0.35 |
| Non-school going | 343 | 0 | 0.0 | 477 | 0 | 0.0 | - |
| Total | 2017 | 5 | 0.3 | 2050 | 8 | 0.4 | 0.42 |
| P value | 0.31 | | | 0.12 | | | |

- Very few among school going adolescents are found to be obese. 3% of

males and 0.5% of females among school going adolescents were found obese.

- None of the non-school going adolescents found to be obese.

**TABLE 5:**

UNDERNOURISHED: AGE AND SEX WISE DISTRIBUTION OF UNDERNOURISHED AMONG STUDY POPULATION: MALE

| Age | Male | | Undernourished | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10 | 202 | 6 | 57 | 28.2 | 22.2, 34.5 | 3 | 50.0 | 10.0, 90.0 |
| 11 | 191 | 5 | 65 | 34 | 27.3, 40.8 | 1 | 20.0 | -15.1, 55.1 |
| 12 | 198 | 8 | 59 | 29.8 | 23.4, 36.2 | 2 | 25.0 | -5.0, 55.0 |
| 13 | 187 | 7 | 95 | 50.8 | 43.6, 58 | 2 | 28.6 | -4.9, 62.0 |
| 14 | 187 | 13 | 89 | 47.6 | 40.4, 54.8 | 5 | 38.5 | 12.0, 64.9 |
| 15 | 180 | 22 | 94 | 52.2 | 44.9, 59.5 | 11 | 50.0 | 29.1, 70.9 |
| 16 | 163 | 37 | 62 | 38 | 30.6, 45.5 | 15 | 40.5 | 24.7, 56.4 |
| 17 | 156 | 42 | 78 | 50 | 42.2, 57.8 | 22 | 52.4 | 37.3, 67.5 |
| 18 | 102 | 101 | 53 | 52 | 42.3, 61.7 | 50 | 49.5 | 39.8, 59.3 |
| 19 | 108 | 102 | 54 | 50 | 40.6, 59.4 | 52 | 51.0 | 41.3, 60.7 |

S – School going, N.S – non-School going; n - Total numbers;
C.I - Confidence Interval

- Both School going and non-school going children's are affected equally.
- Undernourished almost approaches 50%of the male adolescents as the age advances.
- At 10years undernourished starts as 28.2% and approaches 52%by 18 years.
- While among non-school going group there seems to be uniform pattern of under nutrition at a constant rate of around 50% excepting in the early adolescence where they were around 20%to 30%

**TABLE 6:**

OVERWEIGHT: MALE

| Age | Male | | Overweight | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10 | 202 | 6 | 0 | 0.0 | - | 0 | 0.0 | - |
| 11 | 191 | 5 | 0 | 0.0 | - | 0 | 0.0 | - |
| 12 | 198 | 8 | 10 | 5.1 | 2.0, 8.1 | 0 | 0.0 | - |
| 13 | 187 | 7 | 5 | 2.7 | 0.4, 5.0 | 0 | 0.0 | - |
| 14 | 187 | 13 | 11 | 5.9 | 2.5, 9.3 | 0 | 0.0 | - |
| 15 | 180 | 22 | 6 | 3.3 | 0.7, 6.0 | 0 | 0.0 | - |
| 16 | 163 | 37 | 4 | 2.5 | 0.1, 4.8 | 0 | 0.0 | - |
| 17 | 156 | 42 | 2 | 1.3 | -0.5, 3.0 | 0 | 0.0 | - |
| 18 | 102 | 101 | 3 | 2.9 | -0.3, 6.2 | 2 | 2.0 | 0.7, 4.7 |
| 19 | 108 | 102 | 2 | 1.9 | -0.7, 4.4 | 0 | 0.0 | - |

- Among school going adolescents 1.3% to 5.9% were overweight.
- There were no adolescents found overweight in non-school going adolescents.

**TABLE 7:**
OBESITY IN MALE**:**

| Age | Male | | Obesity | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10 | 202 | 6 | 0 | 0.0 | - | 0 | 0.0 | - |
| 11 | 191 | 5 | 0 | 0.0 | - | 0 | 0.0 | - |
| 12 | 198 | 8 | 0 | 0.0 | | 0 | 0.0 | - |
| 13 | 187 | 7 | 5 | 2.7 | 0.4, 5.0 | 0 | 0.0 | - |
| 14 | 187 | 13 | 0 | 0.0 | - | 0 | 0.0 | - |
| 15 | 180 | 22 | 0 | 0.0 | - | 0 | 0.0 | - |
| 16 | 163 | 37 | 0 | 0.0 | - | 0 | 0.0 | - |
| 17 | 156 | 42 | 0 | 0.0 | - | 0 | 0.0 | - |
| 18 | 102 | 101 | 0 | 0.0 | - | 0 | 0.0 | - |
| 19 | 108 | 102 | 0 | 0.0 | - | 0 | 0.0 | - |

- Only male adolescents in age group of 13 were found to be obese.
- No other age group has any adolescents classified as obese in both school going and non-school going.

**TABLE 8:**
UNDERNOURISHED IN FEMALE:

| Age | Female | | Undernourished | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | School going (S) | | | Non-.School going (NS) | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10 | 189 | 3 | 51 | 27.0 | 20.7, 33.3 | 1 | 33.3 | -20.0, 86.7 |
| 11 | 208 | 4 | 83 | 39.9 | 33.2, 46.6 | 2 | 50.0 | 1.0, 99.0 |
| 12 | 196 | 7 | 73 | 37.2 | 30.5, 44.0 | 2 | 28.6 | -4.9, 62.0 |
| 13 | 203 | 10 | 66 | 32.5 | 26.1, 39.0 | 3 | 30.0 | 1.6, 58.4 |
| 14 | 185 | 20 | 34 | 18.4 | 12.8, 24.0 | 3 | 15.0 | -0.6, 30.6 |
| 15 | 165 | 32 | 28 | 17.0 | 11.2, 22.7 | 5 | 15.6 | 3.0, 28.2 |
| 16 | 180 | 35 | 35 | 19.4 | 13.7, 25.2 | 10 | 28.6 | 13.6, 43.5 |
| 17 | 136 | 64 | 67 | 49.3 | 40.9, 57.7 | 27 | 42.2 | 30.1, 54.3 |
| 18 | 65 | 144 | 24 | 36.9 | 25.2, 48.7 | 74 | 51.4 | 43.2, 59.6 |
| 19 | 48 | 156 | 18 | 37.5 | 23.8, 51.2 | 60 | 38.5 | 30.8, 46.1 |

- Undernourished seems to be constant ranging from 27% to 37% among all the age groups of the school going female adolescents. The only exception to the rule is middle adolescence (14,15and 16years of age) where it over between 17% and 19%.
- Among the non-school going female adolescents middle adolescence shows similar trend with undernourished ranging from 15%to 25%. While the rest of the group have a range between 30% and 50%.

**TABLE 9:**

OVER WEIGHT IN FEMALE:

| Age | Female | | Overweight | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10 | 189 | 3 | 4 | 2.1 | 0.1, 4.2 | 0 | 0.0 | |
| 11 | 208 | 4 | 16 | 7.7 | 4.1, 11.3 | 0 | 0.0 | - |
| 12 | 196 | 7 | 0 | 0.0 | - | 0 | 0.0 | - |
| 13 | 203 | 10 | 0 | 0.0 | - | 0 | 0.0 | - |
| 14 | 185 | 20 | 13 | 7.0 | 3.3, 10.7 | 0 | 0.0 | - |
| 15 | 165 | 32 | 0 | 0.0 | - | 0 | 0.0 | - |
| 16 | 180 | 35 | 5 | 2.8 | 0.4, 5.2 | 0 | 0.0 | - |
| 17 | 136 | 64 | 4 | 2.9 | 0.1, 5.8 | 6 | 9.4 | 2.2, 16.5 |
| 18 | 65 | 144 | 4 | 6.2 | 0.3, 12.0 | 0 | 0.0 | - |
| 19 | 48 | 156 | 3 | 6.3 | -0.6, 13.1 | 0 | 0.0 | - |

- Over weight more in the 11 years (7.7%) and 14 years (7.0%) among school going adolescents.
- While all the female adolescents in non-school going over weight were seen in the 17years of age.

**OBESITY**

- Very few were affected by obesity in 13years(1.0%),14 years(1.1 %)and 16 years(2.2 %) among school going adolescents
- None of the female adolescents found to be obese among non school going adolescents

**TABLE 10:**

**UNDER NOURISHED:**

DISTRIBUTION OF UNDERNOURISHED AMONG STUDY POPULATION IN VARIOUS STAGES OF ADOLESCENCE: MALE

| Age | Male | | Undernourished | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | S | | | N.S | | |
| | S | N.S | n | % | 95 % C.I | n | % | 95% C.I |
| 10-13 | 778 | 26 | 276 | 35.5 | 32.1, 38.9 | 8 | 30.8 | 13.1, 48.5 |
| 14-16 | 530 | 72 | 245 | 46.2 | 42.0, 50.4 | 31 | 43.1 | 31.7, 54.5 |
| 17-19 | 366 | 245 | 185 | 50.6 | 45.5, 55.7 | 124 | 50.6 | 44.3, 56.9 |

Among the school going:

- Early adolescents 35.5% of male were undernourished.
- Middle adolescents 46.2% of male were under nourished.
- Late adolescents 50.6 of male were under nourished.

Among the Non-school going:

- Early adolescents 30.8% of male were under nourished.
- Middle adolescent 43.1% of male were under nourished.
- Late adolescent 50.6% of male were under nourished.
- In both the groups undernourishment was more common in late adolescents.

**TABLE 11:**

OVERWEIGHT:

| Age | Male | | Overweight | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | S | | | N.S | | |
| | S | N.S | n | % | 95% C.I | n | % | 95% C.I |
| 10-13 | 778 | 26 | 15 | 1.9 | 0.9, 2.9 | 0 | 0.0 | - |
| 14-16 | 530 | 72 | 21 | 4.0 | 2.3, 5.7 | 0 | 0.0 | - |
| 17-19 | 366 | 245 | 7 | 1.9 | 0.5, 3.3 | 2 | 0.8 | 0.3, 1.9 |

- Among school going 1.9%, 4.0% and 1.9% in Early, Middle and Late adolescents were overweight.
- Only 2 adolescents among non-school going in late adolescence were overweight.

**OBESITY:**

- Only 5(0.6%) adolescents in early adolescence among school going were obese.

- None of the male adolescents were affected by obesity among non school going.

**VARIOUS STAGES OF ADOLESCENCE FEMALE**

**TABLE 12:**

**UNDER NOURISHED:**

| Age | Female | | Undernourished | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95% C.I | n | % | 95% C.I |
| 10-13 | 796 | 24 | 273 | 34.3 | 31.0, 37.6 | 8 | 33.3 | 14.4, 52.2 |
| 14-16 | 530 | 87 | 97 | 18.3 | 15.0, 21.6 | 18 | 20.7 | 12.2, 29.2 |
| 17-19 | 249 | 364 | 109 | 43.8 | 37.6, 50.0 | 161 | 44.2 | 39.1, 49.3 |

Among the school going:

- Early adolescents 34.3% of female were undernourished.
- Middle adolescents 18.3% of female were under nourished.
- Late adolescents 43.8%of female were under nourished.

Among the Non-school going:

- Early adolescents 33.3% of female were under nourished.
- Middle adolescent 20.7% of female were under nourished.
- Late adolescent 44.2% of female were under nourished.
- Under nourished are more common in the late adolescence in both school going (43.8%) and non-school going adolescents (44.2%).

**TABLE 13:**

**OVERWEIGHT**

| Age | Female | | Overweight | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | | N.S | | |
| | | | n | % | 95 % C.I | n | % | 95 % C.I |
| 10-13 | 796 | 24 | 20 | 2.5 | 1.4, 3.6 | 0 | 0.0 | - |
| 14-16 | 530 | 87 | 18 | 3.4 | 1.9, 4.9 | 0 | 0.0 | - |
| 17-19 | 249 | 364 | 11 | 4.4 | 1.9, 6.9 | 6 | 1.7 | 0.4, 3.0 |

- Overweight among school going adolescents were 2.5%, 3.4% and 4.4% in early, middle and late adolescence respectively.
- Almost none in non-school going was overweight.

**OBESITY:**

- Only 2(0.3%) and 6(1.1%) female adolescents in early and middle adolescence respectively were affected by obesity among school going.
- None of the non school going female adolescents were affected by obesity

**ANEMIA:**

**TABLE 14:**

DISTRIBUTION OF HEMOGLOBIN AMONG STUDY POPULATION:

VARIOUS STAGES OF ADOLESCENCE IN MALE

| Age | >12 grams | | 7-12 grams | | | | < 7 grams | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S | N. S | School going | | Non School going | | School going | | Non School going | |
| | | | n | % | n | % | n | % | n | % |
| 10-13 | 529 | 16 | 211 | 27.1 | 9 | 34.6 | 38 | 4.9 | 1 | 3.9 |
| 14-16 | 324 | 50 | 195 | 36.8 | 17 | 23.6 | 11 | 2.1 | 5 | 6.9 |
| 17-19 | 304 | 203 | 60 | 16.4 | 39 | 15.9 | 2 | 0.6 | 3 | 1.2 |

- 27.1%, 36.8% and 16.4% school going early, middle and late adolescence respectively were mildly anemic.
- 34.6%, 23.6%and 15.9% of non-school going early, middle and late adolescence respectively were mildly anemic.
- As the age advances prevalence of mild anemia decreased from 34.6%to 15.9%.
- 4.9%, 2.1% and 0.6% among school going early, middle and late adolescence were severely anemic.
- 3.9%, 6.9% and 1.2% among non-school going early, middle and late adolescence were severely anemic.

**TABLE 15:**
DISTRIBUTION OF HEMOGLOBIN AMONG STUDY POPULATION VARIOUS STAGES OF ADOLESCENCE IN FEMALE

| Age | >12 grams | | 7-12 grams | | | | < 7 grams | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S | N.S | S | | N.S | | S | | N.S | |
| | | | n | % | n | % | n | % | n | % |
| 0-13 | 441 | 12 | 290 | 36.4 | 7 | 29.2 | 65 | 8.2 | 5 | 20 |
| 14-16 | 216 | 38 | 272 | 51.3 | 36 | 41.4 | 42 | 7.9 | 13 | 14.9 |
| 17-19 | 141 | 204 | 103 | 41.4 | 154 | 42.3 | 5 | 2.0 | 6 | 1.7 |

- 36.4%, 51.3% and 41.4% of school going female of early, middle and late adolescents were affected by mild anemia respectively
- 29.2%, 41.4% and 42.3% of non-school going female of early, middle and late adolescents were affected by mild anemia respectively.
- 8.2%, 7.9% and 2.0% of school going early, middle and late adolescents were affected by severe anemia respectively.
- 20.8%, 14.9% and 1.7% of non-school going early, middle and late adolescents were affected by severe anemia respectively.
- There was a decreasing trend of severe anemia from early adolescents to late adolescents in both school going and non-school going.

**TABLE 16:**

PREVALENCE OF ANEMIA IN SCHOOL GOING AND NON-SCHOOL GOING ADOLESCENTS**:**

| Anemia in school going and Non school going | Male | | | Female | | | P value |
|---|---|---|---|---|---|---|---|
| | Total | n | % | Total | n | % | |
| S | 1674 | 517 | 30.9 | 1575 | 777 | 49.3 | 0 |
| N.S | 343 | 74 | 21.6 | 477 | 221 | 46.3 | 0 |
| Total | 2017 | 591 | 29.3 | 2050 | 998 | 48.7 | 0 |
| P value | 0.0006 | | | 0.25 | | | |

- Anemia in school going male 30.9% and in female 49.3%.
- Anemia in non-school going male 21.6% and in female 46.3%.
- Over all incidence of anemia in male 29.3% and in female 48.7%.

- Female adolescents were significantly more anemic than their male counterpart. In all the 3 groups (49.3%) as compared to(30.9%) among school going(p 0.00),46.3%as compared to 21.6% among non school going(p 0.00) and totally 48.7% as compared to 29.3%(p 0.00) respectively.
- Among the male adolescents school going were significantly more anemic (30.9%) than non-school going (21.6%) (p value 0.0006).

**TABLE 16:**

AGE WISE DISTRIBUTION OF HEMOGLOBIN IN MALE

| Age | >12gms | | 7-12 grams | | | | < 7 grams | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | S | | N.S | | S | | N.S | |
| | S | N.S | n | % | n | % | n | % | n | % |
| 10 | 159 | 4 | 33 | 16.3 | 2 | 33.3 | 10 | 5.0 | 0 | 0.0 |
| 11 | 151 | 2 | 26 | 13.6 | 3 | 60.0 | 14 | 7.3 | 0 | 0.0 |
| 12 | 116 | 5 | 72 | 36.4 | 3 | 37.5 | 10 | 5.1 | 0 | 0.0 |
| 13 | 103 | 5 | 80 | 42.8 | 1 | 14.3 | 4 | 2.1 | 1 | 14.3 |
| 14 | 107 | 9 | 78 | 41.7 | 3 | 23.1 | 2 | 1.1 | 1 | 7.7 |
| 15 | 99 | 14 | 77 | 42.8 | 6 | 27.3 | 4 | 2.2 | 2 | 9.1 |
| 16 | 118 | 27 | 40 | 24.5 | 8 | 21.6 | 5 | 3.1 | 2 | 5.4 |
| 17 | 121 | 37 | 33 | 21.2 | 4 | 9.5 | 2 | 1.3 | 1 | 2.4 |
| 18 | 93 | 90 | 9 | 8.8 | 11 | 10.9 | 0 | 0.0 | 0 | 0.0 |
| 19 | 90 | 76 | 18 | 16.7 | 24 | 23.5 | 0 | 0.0 | 2 | 2.0 |

- Among school going adolescents mild anemia more common in 13 to 15 years age group
- In non-school going adolescents it has no particular age predilection.

**TABLE 17:**
AGE WISE DISTRIBUTION OF HEMOGLOBIN IN FEMALE

| Age | > 12 grams | | 7-12 grams | | | | < 7 grams | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | S | | N.S | | S | | N.S | |
| | S | N.S | n | % | n | % | n | % | n | % |
| 10 | 120 | 2 | 69 | 36.5 | 1 | 33.3 | 0 | 0.0 | 0 | 0.0 |
| 11 | 94 | 2 | 97 | 46.6 | 1 | 25.0 | 17 | 8.2 | 1 | 25.0 |
| 12 | 100 | 3 | 75 | 38.3 | 2 | 28.6 | 21 | 10.7 | 2 | 28.6 |
| 13 | 127 | 5 | 49 | 24.1 | 3 | 30.0 | 27 | 13.3 | 2 | 20.0 |
| 14 | 93 | 7 | 72 | 38.9 | 8 | 40.0 | 20 | 10.8 | 5 | 25.0 |
| 15 | 59 | 14 | 89 | 53.9 | 13 | 40.6 | 17 | 10.3 | 5 | 15.6 |
| 16 | 64 | 17 | 111 | 61.7 | 15 | 42.9 | 5 | 2.8 | 3 | 8.6 |
| 17 | 76 | 40 | 58 | 42.6 | 22 | 34.4 | 2 | 1.5 | 2 | 3.1 |
| 18 | 36 | 68 | 28 | 43.1 | 74 | 51.4 | 1 | 1.5 | 2 | 1.4 |
| 19 | 29 | 96 | 17 | 35.4 | 58 | 37.2 | 2 | 4.2 | 2 | 1.3 |

- There is no particular age predilection for mild anemia both in school going and non-school going.
- Severe anemia is more common from 13 to 15 years in both school going and non school going adolescents

**TABLE 18:**

MEAN HEIGHT AND WEIGHT**:**

| Age | Mean Height | Mean Weight |
|---|---|---|
| 10 M | 124.13 | 23.30 |
| 10 F | 123.35 | 22.88 |
| 11 M | 131.88 | 26.66 |
| 11 F | 128.93 | 26.00 |
| 12 M | 133.02 | 28.52 |
| 12 F | 136.72 | 29.79 |
| 13 M | 138.32 | 29.72 |
| 13 F | 143.42 | 33.89 |
| 14 M | 144.29 | 33.52 |
| 14 F | 146.91 | 37.17 |
| 15 M | 154.51 | 39.52 |
| 15 F | 147.76 | 39.99 |
| 16 M | 161.96 | 46.80 |

| | | |
|---|---|---|
| 16 F | 150.40 | 42.66 |
| 17 M | 166.32 | 49.99 |
| 17 F | 151.41 | 43.32 |
| 18 M | 172.39 | 50.63 |
| 18 F | 153.09 | 44.82 |
| 19 M | 173.48 | 53.05 |
| 19 F | 155.37 | 46.81 |

The mean height and weight of different age group are as follows (age wise)

Mean height in male was 124.13, 131.88, 133.02, 138.32, 144.29, 154.51, 161.96, 166.32, 172.39 and 173.48 in 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 years respectively. Mean height in female was 123.35, 128.93, 136.72, 143.42, 146.91, 147.76, 150.40, 151.41, 153.09 and 155.37 in 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 years respectively.

Mean weight in male was 23.3, 26.6, 28.5, 29.7, 33.5, 39.5, 46.8, 49.9, 50.6 and 53.05 in 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 years respectively. Mean weight in female was 22.88, 26, 29.79, 33.89, 37.17, 39.9, 42.66, 43.32, 44.82 and 46.81 in 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 years respectively.

TABLE 19:

PREVALENCE OF STUNTING**:**

| Age | < 3rd Percentile | | | |
|---|---|---|---|---|
| | Male | | Female | |
| | (%) | N | (%) | n |
| 10 | 76.9 | 160 | 69.80 | 134 |
| 11 | 33.60 | 66 | 63.08 | 135 |
| 12 | 65.04 | 134 | 54.10 | 110 |
| 13 | 56.60 | 111 | 46.94 | 100 |
| 14 | 63.80 | 129 | 59.02 | 121 |
| 15 | 40.09 | 81 | 52.28 | 103 |
| 16 | 36.50 | 73 | 30.69 | 66 |
| 17 | 31.30 | 62 | 46.50 | 93 |
| 18 | 29.06 | 59 | 29.66 | 62 |
| 19 | 29.0 | 58 | 29.0 | 60 |

Among boys, prevalence of stunting declining trend from 76.9%at 10 years of age to 29% at 19 years of age. Among girls prevalence of stunting declining trend from 69.8%at 10 years of age to 29% at 19 years of age. Stunting is more common among boys from 10 years of age to 14 years of age than girls. After 14 years of age stunting is more common in girls than boys. High prevalence of stunting in age group 10 in both between male and female and showing decreased trend as age advances probably indicate an element of constitutional delay. The average stunting was 46.18% in males and to 48.1% in females.

## DISCUSSION

India is a signatory of millennium developmental goals (MDG) by 2020 and marches towards the achievement of goals. Health planners and policy makers allocate resources towards health care based on the infant, maternal mortality rates. In spite of generous allocation of funds neonatal mortality rate and low birth weight in India are still at a very high level. This puts a question mark over the ability of our country MDG

by 2020. It has already been recognized that malnutrition and anemia among the adolescents is the major contributory factor to Low birth weight. This study was an attempt to estimate the prevalence of malnutrition and anemia among the adolescents living in rural areas.

Overall prevalence of anemia in this study was 29.3% among male and 48.7% in females. Undernourishment is almost 50% in both sexes. Stunting was 46.18% in males and to 48.1% in females. But in the study conducted by K. Anand et al [8] in whose study there was prevalence of anemia 38%, 43.8% in boys and girls respectively. Undernourished in their study was 43.8%, 30.8% in boys and girls respectively. Stunting in their study was 43.8% in boys and 30.1% in girls. This difference could be due to that the study done by them was only included school going adolescents. But in our study we included non-school going also. The non-school going adolescents were more in numbers as the age advances.

In a study by Sabita Basu et al [18] shows that anemia among girls 23.9% and in boys 7.7%, undernourishment in girls 14.3% and boys 14.2%. This difference also may be due to that non-inclusion of the non-school going adolescents their studies.

Study conducted by Rajarathnam Abel et al[4] shows that the prevalence of anemia among girls was 45%, which was almost equal to our study report. 50% of rural adolescents female were undernourished in our study, which is similar to the study done by Srivastava .M et al[7].

Malnutrition seems to be rampant among adolescent in all the developing countries (MassaweS (2002)) [20] and this study also highlights the same. This study also confirms that nutritional status of adolescents continues to be poor in this part of country as in other parts of country( Choudhary .S et al[6]& K. Anand et al[8]). and the pattern of undernourishment was not related to literacy. There was a group in which literacy seems to have played wee bit a tiny role only among girls. This difference may be due to the increased workload burden on non-school going adolescent girls rather than literacy. This study has shown that undernourishment was more common in boys than girls.

A study by Dr.C. Ravichandran et al[21] in pre adolescent age group (unpublished)[21] also established that under nutrition was more in the male. This difference may be due to the onset of pubertal growth velocity at a later age in the males when compared to girls.

This study reflects the general pattern of anemia is more among girls than in boys and the general trend of anemia 45to55% as per NFHS- II data[25]. Though the cause of anemia was not within the preview of this study, it can be safely assumed that majority of them are nutritional and mostly iron deficiency type as derived from other studies (Sharda Sidhu1 et al[3], Jolly Rajarathnam et al[4]& Sabita Basu et al [18]). The significant number of anemic is in the middle adolescent age group, could be explained by the fact that menarche is attained around 12 years and the first few cycles

are irregular with increased blood loss. So any policy towards low birth weight and neonatal mortality needs the policy makers to make a note of this alarming trend of anemia among adolescent girls. It is disheartening to note that even adolescent boys are anemic .At present it must be noted that there is no definite policy or interventional programs directed against male adolescents. In rural areas adolescent pregnancy is more common due to early marriage in adolescent girls. Hence the interventions have to be done against anemia and under nutrition among the adolescent girls thereby preventing low birth weight and neonatal mortality.

Limitations of the study

- History about menarche and Tanners maturity rating could not be done due to social reasons. Comparison of male and female nutritional status including stunting if done based on Tanners maturity rating would have been more accurate than comparing among age group.
- The etiological pattern of anemia was not done due financial constraint.
- Ferritin value would have given the iron storage among the anemic. But could not be done due financial constraint.

## CONCLUSION

- Under nutrition was found to be a significant problem in both sexes of rural adolescents.
- Late adolescents were more undernourished in both sexes.
- Under nutrition was more common in boys than in girls
- Obesity was not at all a problem among rural adolescents in both sexes.
- Anemia was more common in female than in male in both school going and non-school going.
- Anemia was more common in non-school going than in school going in both sexes.
- Severe anemia was more common in female of non-school going group.

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## ANNEXURE

## PROFORMA:

| | |
|---|---|
| Name | : |
| Father's / Guardian's Name | : |
| Age | : |
| Sex | : |
| Date of Birth | : |
| School going / Non-school going | : |
| Address | : |
| | |
| Height | : |
| Weight | : |
| Body Mass Index | : |
| Hemoglobin (gms / dl) | : |